

## **REMARKS/ARGUMENTS**

### **Allowed Claims**

Claims 22-25, 27-30 and 32-33 were allowed in paragraph 7 on page 4 of the Office Action dated September 23, 2003. Therefore, the following remarks do not apply to these allowed claims.

Claim 34 was also allowed in paragraph 7 on page 4 of the Office Action dated September 23, 2003. However, Claim 34 depends from Claim 18 that in turn was rejected over the prior art. Applicants believe that allowance of Claim 34 over the prior art is justified. Accordingly, Claim 34 has been re-written in independent form, thereby to place Claim 34 in form for allowance. Therefore, Applicants respectfully submit that Claim 34 should be allowed to proceed to issuance.

### **Rejection of Claims 1-6 and 8-17**

Claim 1 was rejected under 35 USC §112, second paragraph, as being indefinite (see page 2, paragraph 2 of the above-identified Office Action). The Examiner stated that Claim 1 was confusing, and suggested that "presence or absence of" should be added to the preamble. Claim 1 has been amended in accordance with the Examiner's suggestion. In view of the amendment, Applicants respectfully request the Examiner to withdraw the §112 rejection of Claim 1.

Applicants submit that the scope of Claim 1 remains unchanged in view of this amendment. If the Examiner believes that the scope of Claim 1 has been changed by this amendment, Applicants respectfully request the Examiner to state on the record, in the next Office Action, the reason for his belief about the change in scope.

Claim 1 was not rejected for any prior art reason. Therefore, Applicants respectfully request the Examiner to allow Claim 1 to proceed to allowance. In addition, the Examiner indicated that Claims 2-6 and 8-17 were allowable (see paragraph 6 on page 4 of the Office Action), except for the above-discussed rejection of Claim 1. Therefore, Applicants respectfully submit that Claims 2-6 and 8-17 are also now in form for allowance.

Rejection of Claims 26 and 31

Claim 26 was rejected under 35 USC 112, second paragraph, as being indefinite (see page 2, paragraph 2 of the above-identified Office Action). The Examiner stated that it was not clear how the limitations in Claim 26 further limit the scope of Claim 22 from which it depends.

Applicants submit that the difference in scope is readily apparent to the skilled artisan in view of the language explicitly recited in these two claims, for at least two reasons. Firstly, Claim 26 requires moving a stage carrying a semiconductor wafer containing the conductive structure at a fixed speed which is not required by Claim 22. Therefore, Claim 22 covers not only the method recited in Claim 26, but Claim 22 also covers a method that is performed without moving the stage, i.e. wherein the stage is kept stationary. A method that makes only one measurement in a single spot with a stationary stage is covered by Claim 22 but not by Claim 26. Secondly, Claim 26 requires performing the act of measuring continuously, thereby to obtain an analog signal which is not required by Claim 22. Therefore, Claim 22 covers not only the method recited in Claim 26, but Claim 22 also covers a method that does not obtain a continuous analog signal. Hence, a series of individual discrete measurements are covered by Claim 22 but not covered by Claim 26.

In view of the just-discussed two differences, Applicants submit that Claim 26 is narrower than Claim 22 for at least two reasons. Therefore, Applicants respectfully request the Examiner to withdraw the §112 rejection of Claim 26. Moreover, Claim 26 depends from Claim 22 which has been allowed. Accordingly, Applicants respectfully submit that Claim 26 is also in form for allowance.

If the Examiner continues the rejection of Claim 26 under 35 USC 112, second paragraph, Applicants respectfully request the Examiner to state on record, in the next Office Action the reason for his belief that Claim 22 has the same scope as Claim 26. For example, please identify what language in Claim 22 is being interpreted by the Examiner to require moving the stage, and what language is being interpreted to require measuring an analog signal continuously.

Claim 31 was also rejected under 35 USC 112, second paragraph, as being indefinite (see page 2, paragraph 2 of the above-identified Office Action). The Examiner stated that it was not clear how the limitations in Claim 31 further limit the scope of Claim 1 from which it depends.

Applicants submit that the difference in scope is once again readily apparent to the skilled artisan in view of the language explicitly recited in these two claims, for at least the following reason. Specifically, Claim 31 explicitly requires that a spatial frequency in the plurality of measurements is found to be equal to inverse of the periodicity of the conductive structure, which is not required in Claim 1. Hence, Therefore, Claim 1 covers not only the method recited in Claim 31 but Claim 1 also covers methods in which such a spatial frequency is found to be, in any way, different from inverse of the conductive structure's periodicity. For example, a method that requires a spatial frequency in the measurements to be twice the inverse periodicity of the conductive structure (i.e. 2f) is covered by Claim 1 but not by covered by Claim 31.

In view of the just-discussed difference, Applicants submit that Claim 31 is narrower than Claim 1. Therefore, Applicants respectfully request the Examiner to withdraw the §112 rejection of Claim 31. Moreover, Claim 31 depends from Claim 1 which has been discussed above as being in form for allowance. Accordingly, Applicants respectfully submit that Claim 31 is also in form for allowance.

If the Examiner continues the rejection of Claim 31 under 35 USC 112, second paragraph, Applicants respectfully request the Examiner to state on record, in the next Office Action the reason for his belief that Claim 1 has the same scope as Claim 31, for example what language in Claim 1 is being interpreted to require finding the spatial frequency to be inverse of the conductive structure's periodicity.

#### Rejection of Claims 18-21

From among all of the pending claims, only four claims (namely Claims 18, 19, 20 and 21) currently stand rejected over the prior art. The prior art being applied to reject these four claims is described at page 3 in paragraph 4 of the Office Action as being the teachings of Smith (US Patent 5,228,776) modified by the teachings of Shakouri (US Patent Application 2002 0126732). When relying on the teachings of Smith, the Examiner

made the following remarks (see the middle portion of page 3 of the Office Action; emphasis added):

Smith discloses in Figs. 1-4 a device and the method in the field of applicant's endeavor for testing an integrity (defect, flaw, quality, irregular features) of a semiconductor wafer with a first conductive structure/layer/portion (metal lines and plurality of vias, thus, inherently periodic in space along a direction A). The device comprises a modulated laser pump (pump beam, electron beam) 44 incident to a surface of the metal lines to evaluate vias. Smith also discloses another laser beam (probe beam) 60, a reflected probe beam is received by a thermal detector 74. The reflection of the probe beam is used to obtain measured results and to compare them to a known wafer pattern (reference wafer/second conductive structure) results stored in memory. (the numeral A has been added by the Examiner, see attachment to the Office Action).

Applicants identify two issues raised by the Examiner's use of Smith's teachings, which have been emphasized in the above-quoted remarks.

Regarding the first issue, a review of Smith's Figs. 1-4 shows only one via 26 (see Figs. 2 and 4). There is no suggestion whatsoever, at least not in Smith's Figs. 1-4, that his method can be applied to a periodic conductive structure. Applicants previously argued the inapplicability of Smith's method to a multi-via structure in the Amendment dated June 25, 2003, in the bottom half of page 9 and at the top half of page 10. These arguments are now incorporated by reference herein, in this current amendment.

Applicants note that the above-quoted remarks in the Office Action of September 25, 2003 do not respond to the Applicants' arguments about the inapplicability of Smith's method to periodic conductive structures. This is an error in the Office Action, per MPEP 707.07(f) which states "Where the applicant traverses any rejection, the examiner should, if he or she repeats the rejection, take note of the applicant's argument and answer the substance of it." The Examiner has not explained, on the record, why the presence of multiple vias (as in a via chain) will not worsen the loss of meaningful information in Smith's signal from a single via, as identified by Smith ("any defects in the line will have a major influence on the transmitted signal"; see column 3, lines 63-64). Applicants

previously argued that if a small crack in Smith's structure causes a loss of meaningful information about a single via, then a periodic conductive structure (which has multiple vias) is likely to cause a worse loss. The Examiner must provide a prior art citation for extending Smith's method to a periodic conductive structure.

In the above-quoted remarks in the Office Action of September 25, 2003, the Examiner stated that spatial periodicity of vias is "inherent" in Smith's teachings. Therefore, the Examiner appears to be using "inherency" as a basis for his rejection. To establish inherency, the Examiner must present some extrinsic evidence which makes clear that a periodic conductive structure is necessarily present in Smith's patent, and that it would be so recognized by persons of ordinary skill. Inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. See, MPEP 2112. As seen from the above-quoted remarks, the Examiner has not presented any rationale or evidence to show the applicability of Smith's method to a periodic conductive structure.

Instead of citing to a specific column and specific line in Smith's text for disclosing or suggesting a periodic conductive structure, the Examiner supplied an attachment with the Office Action. Applicants note that the Examiner's attachment cannot substitute for evidence in the prior art, which is required to support the rejection. In the Examiner's attachment, two vias are shown in the modified FIG. 2: an originally present via 26 has been labeled "via1", and a new hand-drawn via on the right, has been labeled "via2." Within each of the two vias, a vertically upward arrow is added and labeled as "A". Even accepting the Examiner's attachment, Applicants submit that there is no indication whatsoever that the shown structure is necessarily periodic, for the following reasons.

If the Examiner's position is that the new via2 in the Examiner's attachment is located inside another semiconductor die that is adjacent to device 20 in Smith's original FIG. 2, then Applicants submit that such a via2 is not part of a single conductive structure that also contains via1. This is because there is no prior art citation by the Examiner to show that metal lines 22 and 24 continuously span across multiple dice of a wafer.

If the Examiner's position is that via1 and via2 are both located inside a single device 20, then the Examiner's attachment is erroneous because via2 is shown outside of device 20. Even assuming the Examiner's error is remedied, the Examiner is requested to

explicitly identify a prior art citation or rationale for why such a conductive structure is not aperiodic (i.e. why is the shown structure necessarily periodic).

Regarding a second issue with the Examiner's remarks quoted above, Applicants also traverse the comparison of Smith's measurement results with a known wafer pattern (reference wafer/second conductive structure) results stored in memory. Applicants submit that the Examiner has not shown that there is a reasonable expectation of success in extending Smith's method to a periodic conductive structure to provide a known pattern. To the contrary, the Examiner-suggested extension is likely to render Smith's method inoperable. As will be apparent to the skilled artisan, the Examiner-suggested procedure based on known wafer pattern can only be practiced if measurements can be made in a reproducible and identical manner from wafer to wafer in the absence of defects. However, such a method is unlikely to succeed for the following reasons.

As stated by the inventors Peter Borden and Ji-Ping Li in the originally-filed application at page 7, lines 1-8, extension of Smith's method to multiple vias perturbs Smith's measurements in unpredictable ways because Smith's method is based on thermal waves which reflect from any interface (such as the multiple vias). The unpredictability in measurements based on thermal wave reflections (as proposed by the Examiner's extension of Smith's method to a periodic conductive structure) is compounded for another reason. Specifically, Smith's method independently focuses two laser beams at different sites. Such independent focusing of two beams on a multi-via structure requires complicated optical positioning which is nowhere disclosed or suggested by Smith.

For example, a comparison of the Examiners' attachment to the relative locations of Smith's two beams in Smith's original FIG. 4 raises the following issue: after measurement of via1, presumably the method proposed by the Examiner moves the two beams to the right to evaluate via2. In doing so, the probe beam is positioned to the right of via2, and the pump beam is positioned between via1 and via2. However, in this configuration, the pump beam will not reach metal line 22 because metal line 24 has been shown as continuously spanning across the two vias. Note that Smith uses two separated beams, with one beam on an upper metal line on one side of a via and the other beam on a lower metal line on the opposite side of the via, to avoid the problem that measuring over non-

planar surfaces causes unacceptable noise in data generated by use of thermal waves. Therefore, Smith does not teach use of his method over a structure that has a spatial variation in reflective properties. In contrast, as will be apparent to the skilled artisan, a conductive structure of the type recited in Claim 18 has spatial variation in reflective properties due to spatial periodicity. This further negates the Examiner's obviousness argument based on Smith.

In view of the above, Applicants submit that the Examiner's remarks alone are not sufficient as evidence to show that an extension of Smith's thermal-wave method to a multi-via structure yields a known pattern of measurements that are repeatably obtained from wafer to wafer. To overcome the evidence in the record, including the inventor's sworn statements at page 7, lines 1-8 of the original application, the Examiner must cite to an explicit prior art teaching in support of his extension of Smith's method.

In rejecting Claim 18, the Examiner also made remarks about Shakouri at the bottom of page 3 and top of page 4 of the Office Action dated September 25, 2003. However, Applicants note that these remarks are identical to the Examiner's prior remarks in the Office Action dated March 26, 2003. Therefore, the Examiner has once again, failed to take note of the applicant's argument and answer the substance of it as required by MPEP 707.07(f). This is once again, an error in the Office Action. Applicants hereby incorporate by reference the previously made remarks on Shakouri, towards the bottom of page 11 and top of page 8 in the Amendment dated June 25, 2003.

If the Examiner continues to reject Claim 18 over the combined teachings of Smith and Shakouri, Applicants respectfully request the Examiner to show in the next Office Action anything whatsoever in Smith's patent which leads the Examiner to expect success in extending Smith's thermal-wave method to a multi-via structure. In doing so, please identify any language by column number and line number and please identify any illustration by figure number and reference numeral. In the next Office Action, the Examiner must cite a prior art teaching for (1) how to obtain a known pattern in the presence of reflections of thermal wave inherent in a multi-via structure and (2) how to repeatably focus two beams independent of one another on such a structure.

Furthermore, the Examiner is respectfully requested to cite in the next Office Action the specific column number and line number where Shakouri teaches that the phase

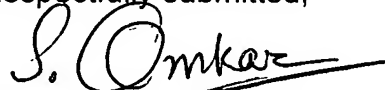
**difference is larger** for a defective conductive structure (as compared to a non-defective structure).

New Claims 35-39 are added. These claims are supported throughout the originally-filed specification, and are believed to be allowable over the prior art of record.

In view of the above, Applicants believe that all pending claims are in form for allowance. Should the Examiner have any questions concerning this response, the Examiner is invited to call the undersigned at (408) 982-8200, ext. 3.

**Via Express Mail Label No.  
ER 158 137 243 US**

Respectfully submitted,



Omkar K. Suryadevara  
Attorney for Applicants  
Reg. No. 36,320

SILICON VALLEY  
PATENT GROUP LLP

10 Mission College Blvd  
Suite 360  
Santa Clara, CA 95054  
(408) 982-8200  
FAX (408) 982-8210